Materials Today: Proceedings xxx (xxxx) xxx

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Evaluation of NiO supported on waste sludge for the degradation of 2- chlorophenol

S.N.S. Kamarularifin [a], N. Abdullah [a], H. Abdullah [a], N. Ainirazali [a,b,*]

[a] Faculty of Chemical and Process Engineering Technology, Universiti Malaysia Pahang, 26300 Gambang, Malaysia
[b] Centre of Excellence for Advanced Research in Fluid Flow (CARIFF), Universiti Malaysia Pahang, 26300 Gambang, Malaysia

ARTICLE INFO

Article history:
Available online xxxx

Keywords:
2-CP
Nickel oxide
Waste Sludge
Industrial effluents

ABSTRACT

Due to the harmful consequences for the environment and human health, chlorophenol is regarded as a hazardous pollutant. This study aims to utilize waste sludge material loaded with NiO (NiO/sludge) as a cost-effective adsorbent for the treatment of 2-Chlorophenol (2-CP). The properties of the NiO/sludge were determined by FTIR and XRD analysis. In a batch study of 2-CP degradation, the effectiveness of NiO/sludge was assessed under a variety of conditions, including pH solution (2–8), temperature (28–50 °C), 2-CP initial concentration (20–80 mg/L), and NiO/sludge dosage (10–40 mg/100 mL). The maximum 2-CP degradation of 98% was reached at 50℃, pH 4, 50 mg/L 2-CP, and 0.3 g of NiO/sludge within 3 h of the reaction process. Under the appropriate circumstances, the optimal cation is exchanged among 2-CP molecules and the surface-active NiO/sludge adsorbent sites. This discovery observed that abundant waste sludge from conventional wastewater treatment plants can be further investigated and used as potential natural adsorbent material for the treatment of industrial effluents.

Selection and peer-review under responsibility of the scientific committee of the 6th International Conference of Chemical Engineering & Industrial Biotechnology (ICCEIB 2022).

1. Introduction

Herbicides, polymers, petrochemical products, colourants, and pharma are just a few of the chemical industries that use phenolic compounds as feedstock. Even at a very low level of 0.1 ppm, this substance has been identified as a severe pollutant that can contaminate water. In order to remove the phenolic derivative compound, efforts have been focused on using tried-and-true methods like chemical reactions, reverse osmosis, adsorption ion exchange, and ultrafiltration [1–2]. The adsorption technique is the most popular approach in treating the organic pollutant because the least expensive, no preliminary treatment, simple operation, and reusability [3–4]. In terms of selecting the adsorbent material for the treatment of organic molecules, high adsorbent capacity, large surface area, low operating cost and synthesis process, and ability to aid in the adsorption process are the significant factors that need to be considered. Activated carbon is a common adsorbent material for treating organic pollutants and heavy metals; however, it suffers from harsh reaction temperature that is considered costly.

To date, researchers have discovered various methods, techniques, low-cost materials, and cheap and simple synthesis procedures in designing a suitable adsorbent for organic treatment. By now, the development of low-cost adsorbents by recycling abundant waste materials is considered the most promising approach to solving waste management and disposition issues [4–5]. Soleimani et al. (2023) [4] employed waste cotton fibers to synthesize the cellulose nanocrystals and reinforced them with calcium alginate hydrogels (CN/CNC) as biosorbents for the treatment of methylene blue. The maximum adsorption performance of CN/CNC was 676.7 mg^{-1} fitted with the Langmuir model. The thermal stability and swelling ratio of the CN/CNC were further investigated and verified using the response surface method (RSM) and artificial neural network-salp swarm algorithm (ANN-SSA) model [6].

A low-cost biosorbent of tea waste was studied for the treatment of 2-CP and efficiently can remove the main substance up to 94% after 1 h of the reaction process [7]. Tu et al. (2014) [8] developed a carbon derived from sewage sludge and supported with an iron oxide catalyst (FeSC) for catalytic oxidation of 2-CP. Complete decomposition of 2-CP was achieved for 5 h of the

* Corresponding author.
E-mail address: ainirazali@ump.edu.my (N. Ainirazali).

https://doi.org/10.1016/j.matpr.2023.04.374

Selection and peer-review under responsibility of the scientific committee of the 6th International Conference of Chemical Engineering & Industrial Biotechnology (ICCEIB 2022).